subscriber downlink frequency is required to address user terminals for any given area serviced by the constellation.

In addition to the need to accommodate or minimize overlapping footprints, CTA considered additional factors that impact the amount of downlink spectrum required for a given application. Most importantly, time-sharing, if required, will increase the amount of downlink spectrum required by a system.

For the purposes of this analysis, CTA assumed subscriber downlink channels operating at rates of 9.6 kbps, suggesting the need for channels each having an effective bandwidth of about 25 kHz. Furthermore, in addition to the subscriber downlinks, feeder link channels large enough to support the message traffic collected by the uplink channels are required; CTA assumed feeder link channels operating at data rates of 18.0 kbps, to accommodate the traffic from five 10 kHz uplink channels, requiring an effective feeder link bandwidth of about 30 kHz.

Based on these considerations, and depending on a number of factors, CTA believes that a viable small-to-medium constellation (without overlapping in-plane footprints) could be designed requiring as little as 40 to 80 kHz of downlink spectrum (including both subscriber and feeder downlink channels) at any given instant for any specific satellite. Large constellations having overlapping in-plane footprints, on the other hand, would require at least 130 kHz of downlink spectrum (assuming one feeder downlink and four subscriber downlinks).

B. Little LEO System-1 Could Support Only A Small Constellation.

In the uplink bands proposed for System-1, the availability of channels is limited by the occupation of the spectrum by land mobile users in the U.S. and certain non-U.S. users (e.g., paging systems in Canada). Little LEO licenses will be restricted to narrow channels between the fixed frequencies of the land mobile users. Furthermore, because of interference, even these channels may not be available at all or at certain times. Based on these considerations, it appears that a System-1 operator could expect to have only two usable 10 kHz uplink channels in the 90 kHz uplink band proposed by the Commission for System-1, and these channels must be shared with VITA.

With respect to downlink, CTA believes that System-1 could accommodate one 12 kHz subscriber downlink and one 15 kHz feeder downlink in the proposed System-1 downlink band.

C. Little LEO System-2 Could Support At Least Two Small-To-Medium Constellations Or One Large Constellation.

As in the case of System-1, the uplink channels of System-2 must be shared with terrestrial users, limiting their availability. As a result, CTA estimates that System-2 users could expect to use only about twenty-four 10 kHz uplink channels in the approximately 900 kHz uplink band proposed by the Commission for System-2. Furthermore, these channels must be shared with Orbcomm.

Assuming that CTA's assumptions concerning downlink capacity discussed in subsection IV (A)(2) above proved true, and assuming that any time-sharing requirements with other users were not overly restrictive, CTA believes that the sub-bands in the 137-138 MHz band proposed for System-2 downlinks may be sufficient to support a least two small-

to-medium constellations (without overlapping in-plane footprints), simultaneously serving any footprint area. Assuming such constellations have no more than six satellites, as many as four constellations may be possible.

Sharing of the capacity would be accomplished by a combination of FDM dynamic channel allocation on the uplinks, and time-sharing, if necessary, on the downlinks. The time-sharing procedures would be the same as those that will be used to time-share with the government agencies (NOAA or DOD) (as discussed in subsection G below) also using the downlink bands. CTA does not believe that time-sharing in this band will pose any technical or business impediments for small-to-medium constellations.

On the other hand, the constant coverage requirements of large constellations, in addition to their need for greater downlink spectrum, means that at most, one such system could be accommodated in the System-2 downlink allocations. This assumes that time-sharing restrictions for large constellations in this band would not be overly burdensome.

D. Little LEO System-3 Could Support at Least Two Small-To-Medium Constellations Or One Large Constellation.

The uplink band for System-3 differs from the uplink bands of System-1 and System-2 in that it is not occupied by other terrestrial users. As a result, one can envision up to ten 10 kHz channels in the 100 kHz uplink band proposed for System-3, although it may be possible to configure more channels (narrower than 10 kHz) depending on a range of operating assumptions. However, coordination with the French S80-1 system and Russian RNSS operations in this band may result in the reduction of the number of available channels.

With respect to downlink, the capacity of System-3 appears to be very similar to System-2. That is, CTA believes that the proposed System-3 downlink allocations may be sufficient to support a least two (perhaps up to four) small-to-medium constellations (without overlapping in-plane footprints), simultaneously serving any footprint area, or, (depending on time-sharing restrictions) a single large constellation.

E. System-1 Should Be Merged With System-3.

Given the severe limitations of System-1, as discussed above, and particularly if there is an absence of interest for such a limited system by any of the second round Little LEO applicants, CTA believes that the spectrum corresponding to System-1 would be better used if it were to be merged with the allocation for System-3. Doing so would add marginally to the uplink capacity of System-3, while also lowering somewhat the time-sharing requirements for the System-3 licensee. The additional System-1 spectrum would help ensure the ability of System-3 to accommodate at least two small-to-medium constellations, or a single large constellation, as discussed above.

F. A "Virtual Constellation" Should Not Be Mandated.

While CTA does not oppose in principle the concept of a "virtual constellation," CTA agrees with the Commission's conclusion that this approach should not be mandated.[36/] Successful collaborations of this kind are built upon mutually compatible business visions and technical requirements. Forcing together companies with differing goals and interests would be a recipe for either outright system failure or a system compromised to the point of marginality.

36/ NPRM ¶ 44.

Even if the applicants decide to implement a virtual constellation on a voluntary basis, achieving technical compatibility among the equipment of the various participants in a "virtual satellite" will be a challenge. To ensure effective and efficient use of spectrum and satellite resources (and to keep the price of user terminals down), the elements of the virtual constellation would have to be compatible in terms of both the radio frequency interface (e.g., carrier frequency, channel assignment, modulation, channel width, symbol rate, Doppler compensation, etc.) and the data packet interface (e.g., packet format, packet networking, forward-error-correction, automatic-repeat-request). Reaching agreement on these technical issues among the participants will be complicated by the different applications participants are developing, and the different markets they wish to serve.

G. Time-Sharing Of The NVNG Spectrum Is Feasible.

CTA believes that the time-sharing with government satellites required for Systems-2 and -3 can be implemented without undue difficulty, as described below. In many cases, however, CTA believes that proper coordination with protected operators may eliminate the need to time-share. CTA would support the involvement of the appropriate government personnel in the development of the Little LEO constellation operations procedures, to insure non-interference with government satellites. Doing so at an early date after Little LEO licensing would be beneficial to both the licensee and the government. CTA also would accept a requirement that places the burden on the Little LEO licensee to prove that a given coordination scheme would avoid interference to the protected operator.

CTA supports the Commission's concept of "protection areas"[37/] as a method for avoiding interference in cases where the Little LEO operator and the government are unable to coordinate so as to avoid overlapping footprints with overlapping frequencies, leading to interference, at any point in time. In accordance with the Commission's proposal, in cases where coordination cannot eliminate interference, CTA recommends requiring Little LEO operators time-sharing with government satellites, on a periodic basis (e.g., daily or weekly) to:

(1) project out the orbits of their satellites and the government satellites with which they are time-sharing, based on their own ephemeris data, and ephemeris data provided by the government satellite operators;

(2) map the footprints of the satellites as they change in time;

(3) identify overlaps of the footprints of Little LEO satellites with the "protection areas" of the government satellites at any point in time;

(4) in areas of such overlap, identify overlapping frequencies that could cause interference; and

(5) upload to the Little LEO satellites timing sequences to change frequencies or temporarily cease transmissions, as necessary to avoid interference.

The same approach could be used between Little LEO operators if time-sharing were required to allow System-2 or System-3 to support more than a single system, as described above. The timing accuracy of the execution of commands in the timing sequence would be limited only by the accuracy of the GPS synchronized satellite on-board clocks, which is clearly sufficient for time-sharing purposes.

37/ Id. ¶ 57.

On the other hand, although CTA believes that the proposals of the Commission regarding the details of coordination with government satellite operators, such as identification of a 24-hour point of contact,[38/] and use of a 48-hour reset time-out,[39/] are prudent measures, CTA does not believe that such measures should be mandated by the Commission in advance of such cooperative efforts between Little LEO licensees and the government. Rather, such issues should be left to the affected Little LEO and government satellite operators to determine, in accordance with the specific requirements of the government systems. Similarly, the means by which ephemeris data is transferred, and the timing of such transfers, should be coordinated by the affected parties themselves.

Furthermore, CTA strongly believes that Commission mandate of a zero degree elevation angle[40/] to calculate the protection area is unnecessarily restrictive, and that the appropriate elevation angle is best left as a subject for coordination. CTA would have no problem, however, with placing the burden on the Little LEO licensee to prove that a given elevation angle would not cause interference to government operations.

V. WRC-95 AND WRC-97 SPECTRUM SHOULD BE ALLOCATED TO SECOND ROUND LICENSEES.

As the Commission correctly points out, second round Little LEO applicants were instrumental in convincing Administrations at the 1995 World Radio Conference ("WRC-95") to allocate additional spectrum for Little LEO systems. These applicants

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38/ Id. ¶ 60.

39/ Id. ¶ 63.

40/ Id. ¶ 61.

expended significant resources, both financial and political, in seeking this additional spectrum, which, as the Commission notes, is itself extremely limited, since there is no corresponding downlink spectrum.[41/] CTA urges the Commission to reward the efforts of the second round licensees by allowing them exclusive use of this spectrum; to do otherwise, and in particular to allow a third round of applicants (who have had no role in convincing the international community to make this spectrum available) access to this spectrum would be highly inequitable.

The Commission explains in the NPRM that it need not open each and every frequency for competing applications before assigning it.[42/] Moreover, given the limited amount of spectrum involved, an allocation to a third group of applicants would be an extremely inefficient use of this resource, because there is no available corresponding downlink to make this additional spectrum useful. CTA urges the Commission to utilize the WRC-95 spectrum for its intended purpose: adding these frequencies to the allocated second round systems to ease the spectrum constraints faced by applicants for these systems.

41/ Id. ¶ 78. For example, CTA committed two full-time staff members, including a high ranking executive, to work with the U.S. delegation in Geneva on the WRC-95 effort.

42/ Id. ¶ 78, citing Rainbow Broadcasting v. F.C.C., 949 F.2d 405, 409-10 (D.C. Cir. 1991).

VI. RESOLVING MUTUAL EXCLUSIVITY WITHOUT AUCTIONS SHOULD BE A PRIORITY FOR THE COMMISSION.

A. A U.S. Auction Of Little LEO Spectrum Would Set A Dangerous Precedent And Could Severely Damage The Satellite Industry.

As the Commission points out, while spectrum auctions can be an efficient administrative tool in appropriate circumstances, the use of competitive bidding to award licenses for global systems raises issues that are considerably more complex and difficult than those raised by the auction of other wireless services.[43/] An essential element that distinguishes the satellite industry from other industries is its inherent international nature. For example, geostationary satellites that serve the United States market also serve significant portions of other countries, including Mexico, Canada and the Caribbean. Mobile satellite systems, including Little LEO and Big LEO systems are by their very nature designed to serve multiple markets around the world. U.S. regulation of satellite systems thus has important implications that spill over our borders into the international arena.

Perhaps most problematic of the issues raised by the auctioning of satellite spectrum is that the use of competitive bidding to award licenses in the United States is likely to mean that satellite service providers will face a series of sequential auctions in different countries around the globe. As the Commission is aware, U.S. regulatory actions frequently serve as a model for regulatory bodies in other countries. The use of spectrum auctions for satellite services in the United States could make it virtually impossible to prevent the use of auctions (or the levying of spectrum fees) by other countries. As the Commission points out, sequential auctions can create significant uncertainty for service providers because they are

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43/ Id. ¶ 80.

unsure that they will win licenses in all of the countries for which they wish to provide services.[44/]

In addition, if satellite providers face sequential auctions in even just a few countries, the cost of building out these systems very quickly will become prohibitively expensive. Indeed, these auction costs could prove to be exorbitant, and could make it impossible for Little LEO and other satellite providers to offer economically viable services. Sequential auctions would make it impossible for satellite service providers to develop a business plan or to calculate their potential return on investment, let alone the capital cost of entering into multiple auctions.

Moreover, as was pointed out in a study on the auction issue prepared by the Satellite Industry Association,[45/] auctions could end up benefitting citizens of other countries more than taxpayers in the United States.[46/] The SIA study suggests that the revenues that would likely be collected from auctions in other countries would correlate to auction prices paid elsewhere, and in the aggregate are likely to be several times larger than the auction revenues collected by the U.S. Treasury.[47/] Furthermore, as the SIA study points out, individual countries conducting auctions will have an incentive to drive up prices by

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[44/] Id. The Commission notes that "[t]his uncertainty may be so severe that, given the high fixed cost of a global system, it may deter entry and impede the provision of service and the development of new offerings." Id.

[45/] "Public Harms Unique to Satellite Spectrum Auctions," a study prepared for the Satellite Industry Association, March 18, 1996 ("SIA Study").

[46/] SIA Study at 3.

[47/] Id. at 23-26.

restricting the supply of satellite spectrum, including, e.g., by warehousing spectrum and opposing new international spectrum allocations.[48/]

CTA urges the Commission to abandon plans for satellite spectrum auctions, and to focus instead on other proven methods of avoiding spectrum scarcity and mutual exclusivity. For example, as the SIA study points out, the Commission historically has used a combination of strict eligibility requirements, more efficient technical rules (e.g., reduced orbital spacing), and expanded frequency bands to accommodate growth in the industry.[49/] As a result, the industry has had an incentive to adopt new technologies that permit more satellites to operate. These efficiency improvements have resulted in enormous benefits to consumers and have resulted in thousands of new jobs.

B. The Commission Does Not Have The Authority To Conduct Auctions For Little LEO Spectrum.

1. The Commission Already Has Determined That It Is Not In The Public Interest To Auction Shared Spectrum.

In the Commission's Second Report and Order [50/] establishing its general competitive bidding rules, the Commission determined that it would exclude from competitive bidding those classes of services in which mutual exclusivity cannot exist because channels must be shared by multiple licensees.[51/] The Commission correctly decided in the

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[48/] Id. at 1.

[49/] Id. at 1.

[50/] In the Matter of Implementation of Section 309(j) of the Communications Act -- Competitive Bidding, PP Docket 93-253, FCC 94-61 (released April 20, 1994) ("Second R&O").

[51/] Second R&O ¶ 13.

Second R&O that shared frequencies should not be auctioned. Indeed, it is almost self-evident that if frequency has to be shared, it cannot be considered mutually exclusive. The Commission's efforts to force shared spectrum in this proceeding into a mutually exclusive situation creates the impression that the Commission is reaching for auctions where they are not appropriate. The Commission offers no justification or explanation for why it now determines that frequencies that are shared nonetheless now can be auctioned.

2. An Auction Of Little LEO Licenses Does Not Advance The Public Interest.

Perhaps most significantly, the Commission does not have authority to auction the NVNG spectrum because NVNG auctions would not meet the public interest test established in Section 309(j)(3) of the Communications Act of 1934, as amended.[52/]

[52/] Under this public interest test, the Commission must determine that the use of a system of competitive bidding will promote the following objectives:

> (A) the development and rapid deployment of new technologies, products, and services for the benefit of the public, including those residing in rural areas, without administrative or judicial delay;
>
> (B) promoting economic opportunity and competition and ensuring that new and innovative technologies are readily accessible to the American people by avoiding excessive concentration of licenses and by disseminating licenses among a wide variety of applicants, including small businesses, rural telephone companies, and businesses owned by members of minority groups and women;
>
> (C) recovery for the public of a portion of the value of the public spectrum made available for commercial use and avoidance of unjust enrichment through the methods employed to award uses of that resource; and
>
> (D) efficient and intensive use of the electromagnetic spectrum.

(continued...)

Auctioning of the spectrum will slow the development and deployment of service to the public and would greatly increase the cost of that service, indeed, perhaps prohibitively so.[53/] In addition, as discussed, the use of auctions will have profound and significantly adverse international implications, including dramatically increased costs and barriers to entry in other countries. Moreover, international auctions would complicate coordination of satellite systems with other governments, further slowing deployment of these systems. At a minimum, auctions would limit the number of firms that are able to compete in the Little LEO industry, increasing concentration of licenses and raising prices to consumers.

In addition, as the SIA study points out, auctions would undermine the FCC's successful policy of accommodating entry by encouraging the industry to move to more efficient technologies, and as noted above, would provide incentives for other countries to warehouse spectrum and orbital resources in order to increase revenues.[54/]

In sum, any of the efficiencies gained domestically by allocating licenses through auctions would be lost in the international arena. Auction of Little LEO spectrum clearly is not in the public interest.

52/ (...continued)
47 U.S.C. 309(j)(3).

53/ The Commission concludes that "[t]o the extent that an auction would allow us to license such systems more quickly than other licensing methods, we believe the public would be served." NPRM ¶ 86. That standard has not been met here.

54/ SIA Study at 22, 24.

VII. NO ADDITIONAL REGULATORY SAFEGUARDS ARE REQUIRED.

CTA agrees with the Commission's conclusion that existing construction and performance milestone requirements are sufficient to prevent warehousing, and that no additional requirements need be imposed. CTA provides comment below on the Commission's proposed anti-collusion and interfering transmission rules.

A. Anti-Collusion Rules Should Not Be Permitted To Stymie Cooperation Among Little LEO Licensees.

The Commission has identified a series of detailed, complex anti-collusion rules that appear to have been drawn from its personal communications services ("PCS") rules. CTA does not believe that these rules are appropriate for application to the Little LEO context. The Commission has long urged the Little LEO applicants to work together to find ways to accommodate all applicants within the existing NVNG spectrum limitations, in large part because it has sought ways to avoid mutual exclusivity and the need for spectrum auctions (and their consequent international implications) for mobile satellite systems in general. CTA urges the Commission not to foreclose the opportunity for the second round applicants to reach agreement on ways to share the existing spectrum by imposing onerous anti-collusion rules.

Since the release of the NPRM, CTA and other Little LEO applicants have been meeting regularly to discuss options for reaching a settlement to ensure the avoidance of mutual exclusivity. The implementation of any anti-collusion rules should be postponed to the last possible opportunity prior to the start of a spectrum auction, in order to afford the Little LEO applicants every chance to reach the desired settlement.

B. Unauthorized And Interfering Transmissions.

In response to the Commission's request for comment on effective methods of preventing unauthorized and interfering transmissions, CTA notes that equipping Little LEO user terminals with position determination capabilities only would be acceptable for certain Little LEO uses, for example, asset tracking services. These position determination devices would not be useful for other Little LEO applications where positions are pre-determined (e.g., fixed low cost units). The cost of Little LEO terminals designed for these purposes must be approximately $100 to enable these services to be economically viable. Adding a position determination device would double the cost of each such unit, clearly undermining the economic viability of this Little LEO service. In addition, requiring fixed units to report their unchanging positions uses valuable system capacity while providing no benefit.

C. The Commission Should Not Prohibit Exclusive Arrangements For Little LEO Systems.

CTA does not support the adoption of limitations on a Little LEO licensee's ability to enter into exclusive arrangements with other countries concerning communications to or from the United States. As the Commission notes, spectrum availability and coordination issues in a particular country may limit the number of systems that can serve that country. Little LEO licensees should not be further penalized for the limited availability of spectrum by being forced to forego commercial opportunities in countries where spectrum availability may be extremely limited.

CONCLUSION

CTA greatly appreciates the efforts of the Commission in crafting the NPRM and in working with the Little LEO applicants to resolve this long-protracted proceeding. CTA believes that the spectrum allocation approach outlined by the Commission, with certain modifications, provides some viable options to the Little LEO applicants. CTA urges the Commission to continue to work with the Little LEO applicants as they strive towards reaching a settlement agreement, and to avoid at all possible cost a potentially disastrous round of spectrum auctions.

Respectfully submitted,

CTA COMMERCIAL SYSTEMS, INC.

By: Michael J. Ladino

Michael J. Ladino
General Counsel
CTA COMMERCIAL SYSTEMS
6116 Executive Blvd.
Suite 800
Rockville, Maryland 20852
(301) 816-1312

By: Diane C. Gaylor

Phillip L. Spector
Susan E. Ryan
Diane C. Gaylor
PAUL, WEISS, RIFKIND,
WHARTON & GARRISON
1615 L Street, N.W.
Suite 1300
Washington, D.C. 20036
(202) 223-7340

Its Attorneys

Date: December 20, 1996

CERTIFICATE OF SERVICE

I, Yasmin Beckford, hereby certify that I have on this 20th day of December 1996, caused to be served a copy of CTA Commercial Systems, Inc.'s Comments by hand-delivery upon the following:

Leslie Taylor, Esq.
Leslie Taylor Associates
6800 Carlynn Court
Bethesda, MD 20817-4302
Counsel for E-Sat Inc.

Aileen Pisciotta, Esq.
Kelly Drye & Warren
1200 19th Street, N.W., Suite 500
Washington, D.C. 20036
Counsel for Final Analysis Communications Services, Inc.

Philip V. Otero, Esq.
Vice President and General Counsel
GE American Communications, Inc.
Four Research Way
Princeton, NJ 08540

Robert A. Mazer, Esq.
Vinson & Elkins
1455 Pennsylvania Av., N.W.
Washington, D.C. 20004
Counsel for Leo One USA Corporation

Albert Halprin, Esq.
Halprin, Temple & Goodman
Suite 650 East Tower
1100 New York Avenue, N.W.
Washington, D.C. 20005
Counsel for Orbcomm

Julie Barton, Esq.
Hogan & Hartson
555 13th Street, N.W.
Washington, D.C. 20004
Counsel for STARSYS

Jonathan Wiener, Esq.
Goldberg, Godles, Wiener & Wright
1229 19th Street, N.W.
Washington, D.C. 20036
Counsel for Volunteers in Technical Assistance

Yasmin Beckford
Yasmin Beckford